bored and killed the tree. Several trees were killed in the same manner. The great peculiarity in these insects is the disparity in size between the females and males, from which it is termed *dispar*. The female is about the eighth of an inch long, while the male is only about two-thirds of this length. The injury begins by a small hole like a shot-hole being bored in the side of the stem, from which a tunnel is made into the pith, and a branch tunnel running horizontally about half, or two-thirds, round the stem. Other tunnels are made straight up and down. These borings, and the destruction of the pith, soon serve to kill the branch. The only remedy appears to be to cut off and burn the infested limb, and "coating the trees with some wash or mixture, which will not hurt the bark but will prevent the beetle getting in or getting out. One application advised for trial is a thick coat of whitewash with some Paris green in it."

There is a detailed account of the winter moth, that arch enemy of apple, pear, and plum growers; this is particularly valuable, as it gives the latest experience of practical growers with respect to preventive and remedial measures. The most important of these is the careful banding of the trees in the autumn, before October, with grease and offensive compounds, to prevent the females from climbing up, and the use of arsenites (Paris green and London purple) for washing or syringing infested trees. These washes have been proved to be efficacious in America, where they are universally applied for many insect attacks. In this country, however, cultivators have hesitated to use them on account of their poisonous nature. Miss Ormerod plainly shows that they may be employed without danger and with vast benefit to the fruit grower. For plum trees, the proportion is 1 ounce of Paris green to 10 gallons of water, and for apple trees 1 ounce to 20 gallons. Testimony is given from various growers as to the efficacy of this wash, which from henceforth will, it is presumed, be adopted, as it seems to be the only one which will check the ravages of moths injurious to fruit trees. Full details concerning the use of these American remedies for insect attack are given, which must be most serviceable.

Want of space prevents allusion to many other insects described in this part of the work. It can only be said that they are clearly and minutely defined, and all that is known of their habits and of means to avert or to modify their mischief is set forth.

The "Manual" is replete with capital figures of the insects in all stages. Many of these are from drawings executed by Miss Ormerod, and many are the well-known accurate and inimitable designs of Curtis.

TORNADOES.

The Tornado. By H. A. Hazen, Assistant Professor of the United States Signal Office. (New York: Hodges, 1890.)

THIS is a book that will hardly enhance the reputation of its author. Despite his assurance (which of course will not be questioned) that he has endeavoured throughout to be absolutely unprejudiced, its apparent aim is not so much to set before the reader a concise description of tornado phenomena as to controvert the views put forward by Ferrel and others relative to their mechanical and physical constitution, and to substitute for these certain other speculations (we can scarcely call them a theory) which appear to the author to have the merit of greater probability. Prof. Hazen does not, indeed, restrict his condemnation to Ferrel's theory of tornadoes and thunder-storms. As a root-and-branch reformer, he finds himself in opposition to the majority of those who, during the last quarter of a century, have built up the fabric of modern meteorology, for, while he speaks with deference of "the epoch-making experiments of Mayer [*sic*] and Joule," he appears to regard as inapplicable to the movements of the atmosphere those laws of thermodynamics which are based on the results of Joule's labours. Were it the practice of scientific authors, in imitation of romance-writers, to head their chapters with quotations appropriate to the subject-matter, chapter v. of this treatise, more especially, might be fitly introduced with the well-known lines from "Faust":—

> "Ich bin der Geist, der stets verneint!
> Und das mit Recht! denn alles was entsteht
> Ist werth, dass es zu Grunde geht";

substituting, however, "*entstanden*" for the present tense of the verb.

Lest it should be thought that these remarks misrepresent or exaggerate the sweeping character of Prof. Hazen's "objections," we extract one or two passages from the chapter in question. On the generally-accepted view that work is performed by an ascending current of air, in pushing aside the atmosphere into which it expands, and that in saturated air the requisite energy is furnished, in part at least, by the condensation of vapour, he observes (p. 52),

"There is nothing in the science of meteorology, or possibly in any physical science, that has been developed from such a worthless origin as this theory of the liberation of energy on the condensation of moisture";

again (p. 54),

"All the reasoning regarding the diminution of temperature in dry and moist air, as we ascend in the atmosphere, is founded upon purely theoretical considerations. Every experiment, whether in the laboratory or in Nature, has proved that these theories, in their sum and substance, are false";

and again (p. 56),

"I am inclined to think that even Espy, with all his disadvantages, was too well informed to adopt such a doubtful and visionary idea as this of effective work performed in the free upper air."

The familiar lecture experiment illustrative of dynamic cooling, in which a cloud is produced in a receiver containing moist air by partially exhausting it with a few strokes of the air-pump, is interpreted in a novel manner consistently with the above opinions (p. 67):—

"The presence of haze or cloud is no evidence of saturated air, for such cloud has been produced in air having only 2 per cent. of moisture.[1] When air is pumped from the room, it has an enormous number of dust particles in it, and these give the appearance of a fog on sudden expansion."

After these samples of the author's opinions it will be scarcely necessary to notice, in detail, the other numerous points on which Prof. Hazen's views are in dissonance with those of most other writers who have treated of tornadoes. Among others, he assures us (p. 57), that "the evidence for [their] gyrations is exceedingly contradictory, and the weight of evidence is overwhelmingly against them"; that (p. 52) it is impossible that warm south wind underruns that which is cooler from the north, "for the denser must always be beneath the lighter"; and (p. 59) that it seems impossible to ascribe the progressive movement of the tornado to the drift of the upper current, "because it moves with a velocity double that of the general storm." Those who are curious to see the further arguments by which these theses are supported must be referred to the work itself. We have yet to notice briefly the alternative views advocated by the author.

---

[1] Prof. Hazen does not give his authority for this statement, nor does he specify whether the expression is to be understood as 2 per cent. of saturation, or 2 per cent. by weight or volume. If the former, authentication seems desirable; if the latter, the fact is obviously irrelevant.

The late Dr. Percy used to relate that, in his early days, when the iron would not "come to nature" in the Staffordshire puddling furnaces, the workmen were accustomed to ascribe its perversity to the presence of sulphur in the charge. In still more remote times, the potentate in whose realm that element is supposed to be somewhat abundant, or his agents, would assuredly have been held responsible for what was amiss. But thirty years ago the march of science had brought in other ideas, and the approved explanation of any otherwise unaccountable difficulty of the kind was that electricity had something to do with it. Even at the present day this mysterious agency is the favourite resource of puzzled tyros in physical reasoning, but we should hardly have expected to find it seriously put forward in all its familiar vagueness by an author whose official designation is that quoted above from the title-page of his work. That such, however, is the case stands in evidence in the following extracts, which we give as fully as our space will admit of, lest we should fail to do their author justice:—

> "It is very difficult to believe that electricity has nothing to do with our thunder-storms, and is merely a result and never a cause. . . . Our thunder-storms seem to show an enormous storehouse of electricity at five thousand or six thousand feet above the earth; at least electricity seems to be concentrated there over thousands of square miles during thunder-storm action. We are taught that electricity forms a sort of dual condition, or the electric field is a double one. May not this electric field draw on the sun for its energy? . . . Why may not the sun's electricity, oftentimes observed by its direct effect on our magnetic instruments, and, more often still, indirectly in our auroras, be intercepted by a peculiar condition of the atmosphere or of the earth below, and thus be concentrated in particular localities?"

This may, perhaps, appear somewhat vague as an alternative theory of storm generation; in one particular, however, viz. the accumulation in the storm-cloud of the enormous quantities of water precipitated in cloudbursts, the *modus operandi* is more fully explained. In Prof. Hazen's opinion, it would seem that electricity performs a part in the atmosphere somewhat analogous to that of Clerk Maxwell's hypothetical demons, and which is described as follows:—

> "Is it inconceivable that we have to deal here with a negative electric field, which draws to itself with great velocity particles of moisture from regions perhaps for one hundred miles about, when suddenly, upon a discharge of electricity, the potential upon the particles is diminished, and they unite in great abundance and form rain-drops?"

This remarkable speculation, it is considered, receives support from a novel experiment described as follows:—

> "A Holz machine was run for fifteen minutes in a rather large room; and most careful measurements of the amount of moisture at the machine and at a point twenty feet away, before and after the machine was in action, showed an increase at the machine. When we consider that it was impossible to measure the moisture contents just at the plate of the machine, and also what an extremely slight charge could by any possibility enter the air from the machine, we can but be surprised that any effect at all was observed."

Without imitating King Charles the Second's scepticism in the matter of the fish's weight in water and out of water, but accepting Prof. Hazen's statement of the results as he gives them, we may still inquire whether the operators who worked the Holz machine continuously for fifteen minutes did not exhale a considerable quantity of water vapour in the neighbourhood of the machine. Perhaps they even perspired freely with their exertion. In any case the foundation seems hardly adequate for the superstructure.

Had this book appeared under a less known name, and were it not for the official position of the writer, we should scarcely have deemed it desirable to notice it at such length. A really searching, intelligent criticism of Ferrel's theory, by one who has exceptional advantages for ascertaining the facts of observation, would have been welcome; for, symmetrical as that theory is, it is still mainly deductive, and there are many points in it, and these not the least important, which still lack confirmation. But we cannot attach much weight to the objections raised by Prof. Hazen. They seem to betray a strange misconception of the physical processes which he condemns in such uncompromising terms; and where his arguments turn on the facts of observation, we must decline to accept his sweeping denials, in the face of the positive testimony of numerous, not incompetent, observers. In some cases, indeed, we might adduce our own personal experience of phenomena which are declared by him to be improbable or impossible. Such are, for instance, the superposition of dry northerly above warm and moist southerly currents, and the spiral movement of the air in dust whirls, which, on a miniature scale, represent that of the tornado.

Again, Prof. Hazen's argument that the rise of pressure beneath a thunder-storm is sometimes observed in storms that are rainless, and therefore cannot be due to the cooling of the air by the rain, or to its downward pressure as it falls, is rendered of little weight by the fact that this occurs only when the lowest strata of the atmosphere are very dry. In the recently published "Climates and Weather of India," it is stated that "a complete transition may be traced between [the rainless dust-storms of Upper India] and the north-westers of Bengal, which are accompanied by heavy rain." In the latter province "the dust-storm is. as a general rule, only the first stage of a north-wester." It is attended with a sudden rise of pressure, and "is followed by heavy rain and sometimes hail," and though the dust-storms of the former are occasionally, though perhaps rarely, quite rainless, "the coolness of the wind and that of the atmosphere after the storm is over is hardly to be accounted for otherwise than by supposing that rain is always formed in the cloud overhead, but is re-evaporated before it reaches the earth."

There is nothing inconsistent in the existence of an excessive pressure at the ground surface beneath a thunder-storm and a diminished pressure in the vortex of the storm-cloud, but in ordinary thunder and hail storms this latter is restricted to the cloud-region. As the barograph traces of these storms show, the oscillations of pressure beneath them are very great, and there may and indeed must be still greater differences between the tornado vortex and the neighbouring region of precipitation. Indeed, the great velocity of the air-movement implies as much.

A part of Ferrel's theory which especially stands in need of confirmation is the assumption that, immediately prior to the formation of the vortex, the vertical distribution of temperature is such as to bring the atmosphere into a state of unstable equilibrium, and that a slight casual local disturbance of this equilibrium starts the vortical uprush. This is also his explanation of cyclone generation, and indeed it is that hitherto held by the majority of writers on the subject. On the other hand, it is generally considered that anticyclones are determined by the greater local density of the atmosphere, due to a low mean temperature of the air-column. The last of these assumptions, even in the case of winter anticyclones accompanied by very low temperatures at the ground surface, has now been conclusively disproved by Prof. Hann, of Vienna; and he has also shown very strong reasons for believing that the temperature conditions of extra-tropical cyclones are also incompatible with the prevailing view. It does not, of course, follow that those of tornadoes and hail-storms are equally so, but at least the assumed conditions require verification. This may, perhaps, be some day effected by our mountain observatories.

H. F. B.

OUR BOOK SHELF.

Inorganic Chemistry: the Chemistry of the Non-Metals. By J. Oakley Beuttler, M.A. (London: Relfe Brothers.)

NOW that there can be obtained a considerable variety of really good text-books of elementary chemistry suitable for all the usual needs of the present day, one is entitled to look for special features in any new manual. We fail to find any reason for the existence of the volume before us: wherein it differs from others that enjoy general recognition, it is incomplete and erroneous. It has neither index nor contents table, but this is quite a trivial matter when compared with the imperfections of the body of the work. On pp. 19 and 20 there are nine attempts at equations, none of which are correct, while many represent impossible or at least unknown reactions; and in the following paragraphs, on graphic notation, bonds, and radicles, there is a collection of statements that read like the imperfect recollections of a student who never understood the subject. A single atom of oxygen is shown with curiously shaped projections as an example of an element with an even number of bonds existing as a single "atom-molecule." It is stated emphatically that "the element having the greatest number of bonds is always printed in thick type," but we search in vain for thick type in any formula in the book. The statements that are intended to convey the facts of chemistry are vague, often misleading, and very rarely of a practical character. For an illustration of the style there is no need to go further than the chapter that treats of the first element, hydrogen. It states that "on throwing a piece of sodium into water the sodium combines with part of the hydrogen of the water to form caustic soda, liberating the other part of the hydrogen." The volume closes, as one would expect, with the questions set by various examining bodies during the last three or four years.

Anatomy, Descriptive and Surgical. By Henry Gray, F.R.S. Twelfth Edition. Edited by T. Pickering Pick. (London: Longmans, Green, and Co., 1890).

OF a solid text-book so well known as the present work it is hardly necessary to say more than that a new edition has appeared. The book has been carefully revised, and the editor has added considerably to its value by introducing sections on topographical anatomy, and amplifying those on surgical anatomy. Both of these classes of sections have been printed in smaller type, so that they may be disregarded by students who wish to confine their attention exclusively to the descriptive part of the subject. There are many new illustrations, some of which are original.

The Story of the Heavens. By Sir Robert Stawell Ball, LL.D. Fifteenth Thousand. (London: Cassell and Co., 1890.)

IT is, for many reasons, satisfactory that there should be a popular demand for a clear, brightly-written work on astronomy. Sir Robert Ball, however, ought hardly to be content with the issue of mere reprints of his book. It may be somewhat misleading to send forth in its original form, in 1890, an astronomical work first published in 1886.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Passage of Electricity through Gases.

IN my letter in NATURE of July 24 (p. 295) I objected to Prof. Schuster's statement that the fact that free atoms must turn a gas into a conductor of electricity was fatal to the theory of the electric discharge given by me in the *Philosophical Magazine* in 1883, and I maintained that the presence of free atoms in a gas free from electric strain was in no way essential to the theory given in that paper. I see no reason, after reading Prof. Schuster's letter in this week's NATURE, to change that opinion. Prof. Schuster bases his statement, not on my description of the theory itself, but on the explanation by it of the weakening of the electric strength produced by a diminution in the density of the gas. A reference to this explanation will show, however, that it really rests solely on the well-known fact that dissociation is assisted by diminution of pressure, and that the passage which Prof. Schuster quotes is merely an explanation of this property of dissociation from the point of view of the kinetic theory of gases; if this explanation is held to be inconsistent with the absence of free atoms from gas in a normal state, then any alteration in the explanation which might be made to meet this difficulty, though of primary importance in the kinetic theory of gases, is only of secondary importance for the theory of the electric discharge given in my paper, which I still maintain is not all bound up with the existence or non-existence of free atoms in gases not in the electric field. J. J. THOMSON.

Cambridge, October 18.

Changing the Apparent Direction of Rotation.

IN NATURE of October 16 (p. 585), a curious optical effect is incidentally mentioned. Standing near a windmill, and nearly